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Map of western Copper River Basin, Alaska, showing lake sediments and shorelines, glacial moraines, and location of stratigraphic sections and radiocarbon-dated samples

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Map of western Copper River Basin, Alaska, showing lake sediments and shorelines, glacial moraines, and location of stratigraphic sections and radiocarbon-dated samples.

by

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Introduction

The purpose of this report is to make available basic data on radiocarbon dating of 61 organic samples from 40 locations in the western Copper River Basin and adjacent uplands and in the uppermost Matanuska River Valley. The former distribution of late Quaternary glacial lakes and of glaciers as mapped from field work and photo interpretation is provided as background for interpretation of the radiocarbon dates and are the basic data needed for construction of the late Quaternary chronology. The glacial boundaries, formed and expressed by moraines, ice-contact margins, marginal channels, deltas, and other features, are obscured by a drape of glaciolacustrine deposits in a series of glacial lakes. The highest lake, represented by bottom sediments as high as 914 m to 975 m above sea level, extends from Fog Lakes lowland on Susitna River upstream into the northwestern part of the Copper River Basin (the part now draining to Susitna River) where it apparently was held in by an ice border. It was apparently dammed by ice from the Mt. McKinley area, by Talkeetna Glacier, and may have had a temporary drainage threshold at the headwaters of Chunilna Creek. No shorelines have been noted within the map area, although Nichols and Yehle (1961) reported shorelines within the 914-975 m range in the Denali area to the north of that mapped. Recent work by geologic consultants for the Susitna Hydroelectric Project has confirmed the early inferences (Karlstrom, 1964) about the

existence of a lake in the Susitna canyon, based originally on drilling by the Bureau of Reclamation about 35 years ago. According to dating of deposits at Tyone Bluff (map locations O, P), Thorson and others (1981) concluded that a late Wisconsin advance of the glaciers between 11,535 and 21,730 years ago was followed by a brief interval of lacustrine sedimentation, and was preceded by a long period of lake deposition broken by a lowering of the lake between 32,000 and about 25,000 years ago. An alternate interpretation of the late Wisconsin till at Tyone Bluff is that it is a glaciolacustrine diamicton of the 914-975 m lake into which the ice advanced to the Hatchet Lake and to the Old Man moraines. The level of this regional lake in the Susitna drainage and on Heartland Ridge then dropped from over 914 m to about 777 m, to uncover the Tyone Spillway. An intermediate lake level in the Susitna-Tyone-Louise lake region was lowered rapidly by erosion of the spillway to 747 m. The drainage of the 747 m lake was concentrated in the spillway leading west from the West Fork Gulkana River. This spillway or a rock threshold downstream apparently was stable enough to permit formation of basin-wide, apparently undeformed, shoreline systems at 747 m, and, on recession, local shorelines at 717 m and 700 m and lower levels. The level of the 747 m lake that was confined to about 9000 km^2 of the present Copper River Basin fluctuated for one or more reasons such as: the volume of ice added to or withdrawn from the system, because of changes in water budget (assuming no outflow), and/or because of temporary releases through the only outlets, perhaps Mentasta Pass, but importantly, the Copper River canyon. The 747 m lake persisted until glaciers had withdrawn to well within the Chugach Mountains, perhaps 10 to 20 km from the present glaciers.

As the map shows, the glaciers moved basinward from each of the surrounding mountain ranges until the ice met in areas such as Heartland Ridge or in the Lone Butte area. The radiocarbon dating at the base of the last drift near the mountains, older than 38,000 years (map locations D, E), suggests that the ice moved into the basin before 38,000 years ago and did not retreat back into the mountains until the final retreat, in the presence of glacial lakes, that took place more than 13,000 years ago as shown at Matanuska glacier (Williams, 1986). The dates more directly related to the last major moraines fall within the category 13,000 to about 25,000 years. Deposits of older glaciations are exposed along rivers and form moraines and ice contact features on the slopes of the Talkeetna Mountains which were in a rain shadow and were not heavily mantled with local ice.

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Map Location: A

Lab	Date	Significance of date
I-11,130	5,570 ± 110	Basal exposed sediment from peat mound in upland bog to provide minmum age for retreat of glaciers.

Stratigraphic section (* denotes sample horizon)

	0 - 0.05 m		Vegetation mat, Sphangum.
	0.05 - 0.38 m		Brown silt, scattered organic material.
*	0.38 - 0.54 m		Light to dark brown silty organic material. Sampled lowermost 1 cm.
	0.54 - 1.65 m		Ice core of peat mound, scattered organic material.
	1.65 - 2.42 m		Cover, frozen to pond level.

Collector, date: O.J. Ferrians, Jr.,1955
Reference: Teledyne Isotopes Inc., Westwood NJ.. written commun., 23, Jan. 1980.

Map Location: B

Lab	Date	Significance of date
L-368	8,450 ± 200	Dated basal local pond deposits provides minimum age for withdrawal of 710-m regional lake and for retreat of glacier from this locality.

Stratigraphic section (* denotes sample horizon)

*	0 - 2.44 m		Massive local pond silt containing silty peat near base of unit.
	2.44 - 4.12 m		Alternately oxidized and reduced silt and sand, horizontal, deposits of 710-m lake.
	4.12 - 15 m		(river level) contorted and collapsed beds and lenses of sand and fine to coarse gravel; ice-contact deposits.

Collector, date: J.R. Williams, 1954
Reference: Olson and Broecker, 1958, p. 597-599; 1959, p. 7.

Map Location: C

Lab	Date	Significance of date
W-715	4,200 ± 200	Dates fluvial (?) sand between eolian sand and underlying glacial drift.

Stratigraphic section (* denotes sample horizon)

	0 -	0.46 m	Eolian sand, sandy peat, and humus.
*	0.46 -	2.6 m	Oxidized brown sand grading from medium sand downward to coarse sand and granule gravel; contains contorted organic beds in middle and vertically oriented boulders at base.
	2.6 -	50.4 m	Stratified section of till, outwash, diamicton and lacustrine deposits.
	50.4 -	62 m	Shale of Matanuska formation.

Collector, date: J.R. Williams, 1957
Reference: Rubin and Alexander, 1960, p. 168.

Map Location: D

Lab	Date	Significance of date
W-842	> 38,000	Dates organic material beneath drift of last major glaciation and above advance outwash.

Stratigraphic section (* denotes sample horizon)

	0 -	3 m	Lacustrine clay, jointed.
	3 -	6.1 m	Gray till or stony diamicton.
	6.1 -	12.2 m	Slump and cover.
	12.2 -	18.3 m	Massive to stratified fine to coarse gravel and massive to bedded sand, cross-bedded fine gravel.
*	18.3 -	20.1 m	Hard, jointed clayey silt, organic material at base.
	20.1 -	23.2 m	Coarse gray gravel channel fills, imbricated, flow to east as at W-295.
	23.2 -	38.2 m	Massive sandy silty gravel (or till) poorly to well stratified at base.
	38.2 -	53.4 m	Shale of Matanuska formation to river level.

Collector, date: J.R. Williams, 1957
Reference: Rubin and Alexander, 1960, p. 168-169.

Map Location: E

Lab	Date	Significance of date
W-295	> 38,000	Peat and woody debris from upper part of lacustrine deposits beneath advance outwash and the overlying drift of last major glacial advance at this location.

Stratigraphic section (* denotes sample horizon)

0	-	1.53 m	Eolian sand.
1.53	-	3.2 m	Sandy gravel.
3.2	-	12. 4 m	Buff till with sandy to silty beds in mid unit.
12.4	-	15.5 m	Sandy gravel, slightly oxidized.
15.5	-	18.3 m	Buff till.
18.3	-	21.7 m	Well imbricated (flow to east), stratified cobble gravel and sandy pebble gravel; locally oxidized. Advance outwash.
* 21.7	-	34 m	Well bedded and contorted fine sand; wood fragments and peat beds. In situ peat sampled at depth of 22.16 m.
34 m			To base at river level, blue gray sandy silt.

Collector, date: J.R. Williams, 1954
Reference: Rubin and Suess, 1956, p. 125-126.

Map Location: F

Lab	Date	Significance of date
W-306	975 ± 160	Dates basal peat provides age of initiation of cliffhead eolian activity.

Stratigraphic section (* denotes sample horizon)

0	-	1.38 m	Sand, silt, interbedded peat and tree stumps.
* 1.38	-	1.53 m	Peat and occasional log and stump; sampled basal peat.
1.53	-	7.66 m	Tan till, upper 1 m oxidized.
7.66	-	9.20 m	Gravel, pinching and swelling.
9.20	-	12.3 m	Buff till
12.3	-	16.1 m	Gray gravel, imbricated, flow to east; advance outwash.
16.1	-	22.2 m	Fine stratified sand (upper part dated by W-295).
22.2	-	37.3 m	Massive stony silt and stratified silt.
37.3 m			To base of river level, cover.

Collector, date: J.R. Williams, 1954
Reference: Rubin and Alexander, 1958, p. 1,482.

Map Location: G

Lab	Date	Significance of date
W-378	2,500 ± 200	Provides minimum age for drainage of local pond that was formed during deglaciation of Tokaina Creek valley.

Stratigraphic section (* denotes sample horizon)

	0	- 0.33 m	Grass and peat slump.
	0.33	- 0.38 m	Grass peat, humus.
	0.38	- 0.53 m	Brown silty, peat, roots.
	0.53	- 0.76 m	Sedge Equisetum peat, little silt.
	0.76	- 0.96 m	Dark brown silty peat.
	0.96	- 1.24 m	Dark brown compressed sedge-grass peat.
*	1.24	- 1.49 m	Black organic silt, alder or willow twigs, spruce litter. Sampled at base.
	1.49	- 1.54 m	Blue gray clay, scattered pebbles.
	1.54	- 1.69 m	Brown sandy clay and sand with pebbles.
	1.69 m		Frozen ground near pond level.

Collector, date: J.R. Williams, 1954
Reference: Rubin and Alexander, 1958, p. 1,482.

Map Location: H

Lab	Date	Significance of date
W-767	10,250 ± 250	Minimum age for 10.7 m terrace and for retreat of glacier from this location. May also provide minimum age for 710 m regional lake, if terrace is graded to lake.

Stratigraphic section (* denotes sample horizon)

0	-	1 m	Shale rubble, colluvium.
1	-	1.02 m	Brown silt.
1.02	-	1.07 m	Shale granule gravel.
1.07	-	1.12 m	Brown silt.
1.12	-	1.16 m	Oxidized coarse sand.
1.16	-	1.39 m	Interbedded silt and silty shale.granule gravel.
1.39	-	1.49 m	Shale granule gravel.
1.49	-	1.51 m	Brown silt.
* 1.51	-	1.58 m	Black peat beds seperated from one another by oxidized sandy silt (sample composite of both peats).
1.58	-	1.66 m	Oxidized silty sand.
1.66	-	4.4 m	Sandy cobble-boulder gravel, terrace deposit Little Nelchina River.
4.4	-	8.1 m	Shale of Matanuska formation.
8.1	-	10.7 m	Cover to river level.

Collector, date: J.R. Williams, 1954
Reference: Rubin and Alexander, 1960, p. 168. Ferrians and Nichols, 1965, p. 109.

Map Location: I

Lab	Date	Significance of date
I-13,645	> 40,000	Sets infinite lower limit on age of surficial drift and gravelly units beneath it; similar to W-295 on Nelchina River.

Stratigraphic section (* denotes sample horizon)

	0	- 3 m	Till.
	3	- 6 m	Cobble gravel.
	6	- 15 m	Coarse boulder gravel.
*	15	- 21 m	Sand and silt, sample near top of embedded log.

Collector, date: J.R. Williams, 1957
Reference: Teledyne Isotopes Inc., Westwood, NJ., written commun., 24, June 1983.

Map Location: J

Lab	Date	Significance of date
I-11,499	2,245 ± 85	Basal peat of upland bog to provide minimum age for glacier retreat.

Stratigraphic section (* denotes sample horizon)

	0	- 0.03 m	Grass, moss, roots.
	0.03	- 0.61 m	Organic siltysand, grading to sand.
	0.61	- 0.63 m	Coarse, angular sand
*	0.63	- 0.78 m	Bedded peat, containing sticks (sample base of unit).
	0.78 m		Gray, reduced sand containing boulders.

Collector, date: J.R. Williams, 1954
Reference: Teledyne Isotopes Inc., Westwood,NJ., written commun., 18, Aug. 1980.

Map Location: K

Lab	Date	Significance of date
W-357	>35,000	Dates fine-grained organic fluvial deposits beneath stream gravel and thin stony silt.

Stratigraphic section (* denotes sample horizon)

	0 - 0.15 m		Surface moss and vegetation.
	0.15 - 1.06 m		Stony silt, silt and cobbles, boulders concentrated near surface, many striated.
	1.06 - 5.65 m		Sandy gravel and slumped gravel.
	5.65 - 6.26 m		Interbedded oxidized sand, greenish gray silt and thin organic beds.
	6.26 - 6.62 m		Greenish gray silt, local pods of oxidized sand and gravel.
	6.62 - 6.82 m		Alternating thin bedded greenish gray silt, peat and oxidized sand.
	6.82 - 6.93 m		Greenish gray and tan silt, thin peat beds near base.
	6.93 - 7.08 m		Greenish gray silt with wood.
*	7.08 - 7.16 m		Compressed fibrous peat.
	7.16 - 7.18 m		White ashy sand.
	7.18 - 7.25 m		Peat.
	7.25 - 7.72 m		Silt, locally containing spruce wood; extends below river level.

Collector, date: J.R. Williams, 1954
Reference: Rubin and Alexander, 1958, p. 1,483.

Map Location: L

Lab	Date	Significance of date
I-11,649	7,440 ± 120	Bog section to provide minimum age for glacial retreat, upper Tolson Creek, beyond lateral moraine.

Stratigraphic section (* denotes sample horizon)

	0 - 0.61 m		Peat and slumped peat.
	0.61 - 0.82 m		Gray silt and sandy silt.
*	0.82 - 1.47 m		Interbedded fine to medium sand and organic silty sand.
	1.47 m		Seasonal frost.

Collector, date: J.R. Williams, 1980
Reference: Teledyne Isotopes Inc., Westwood, NJ., written commun., 26, Nov. 1980.

Map Location: M

Lab	Date	Significance of date
I-11,650	8,070 ± 130	Tyone River terrace (0.5 km below confluence with Tyone Creek, 18 km north of edge of map area).

Stratigraphic section (* denotes sample horizon)

	0	- 0.3 m	Peat and humus.
	0.3	- 1.06 m	Stratified overbank silt and sand.
	1.06	- 3.5 m	Cobble gravel, scattered boulders, sandy.
*	3.5	- 3.65 m	Silt containing sticks and fine organic material.
	3.65	- 3.95 m	Coarse sand, pebbles.
	3.95	- 27 m	Cover to river level.

Collector, date: J.R. Williams, 1980
Reference: Teledyne Isotopes Inc., Westwood NJ., written commun., 4, Dec. 1980.

Map Location: N

Lab	Date	Significance of date
I-11,907	2,290 ± 80	Tyone Creek terrace 945 m south of mouth of Daisy Creek. Date provides age of base of overbank deposits of terrace.

Stratigraphic section (* denotes sample horizon)

	0	- 0.05 m	Vegetation map, peat roots.
	0.05	- 0.06 m	Overbank flood sand, roots.
	0.06	- 0.67 m	Brown thick-bedded sand with beds of peat and organic matter.
	0.67	- 0.92 m	Alternatiang peat beds (6-12 mm thick), sand,and silt. Horizontal spruce root at base.
	0.92	- 1.25 m	Green-gray fine sand with oxidized coarse sand lenses; contins organic flood litter.
*	1.25	- 1.73 m	Brown oxidized sand and interbedded and contorted green gray silt; includes peaty partings; scattered sticks of wood and pods of silty woody debris at base (sampled).
	1.73 m		Sand and gravel, oxidized at top.

Collector, date: J.R. Williams, 1954
Reference: Teledyne Isotopes Inc., Westwood NJ., written commun., 26, May. 1981.

Map Location: O

Thaw Bluff, east bank Susitna River north of Tyone River.

Lab	Date	Significance of date
Beta-1821	11,535 ± 140	Minimum age for underyling sand.
Beta-1820	32,000 ± 2,735	Fluvially reworked lacustrine deposits, similar to 28.5 - 50 m in Tyone Bluff (location P).

(perhaps should be greater than, large counting error).

Stratigraphic section (* denotes sample horizon)

* 0	-	2.5 m	Bog sediments, peat and organic silt; sample depth 2 m.
2.5	-	8 m	Recessional distal outwash, cross-bedded sand at top, gravel at base. Apparently missing in Tyone Bluff (map location P).
* 8	-	14.8 m	Reworked glaciolacustrine deposits, sand, silt, and clay; sample at 4 m below top.

Collector, date: R.M. Thorson and others, 1980
Reference: Thorson and others, 1981, p. 409; Hamilton and Thorson, 1983, fig. 2.7 and p. 47.

Map Location: P

Tyone Bluff (Thorson and others, 1981, p. 404-417).

Lab	Date	Significance of date
DIC-1860	3,200 ± 195	Closely dates a tephra.
DIC-1861	21,730 ± 390	Maximum age limit for glaciolacustrine diamicton (Thorson and others lodgement till).
BETA-1819	29,450 ± 610	Death of Mammoth and burial.
DIC-1862	31,070 + 860 - 960	Dates fluvial reworking of lacustrine deposits.

Stratigraphic section (* denotes sample horizon)

* 0	-	1.7 m	Peat sampled at depth of 1 m.
1.7	-	3.7 m	Silt and clay.
3.7	-	12.5 m	Lodgement till according to Thorson and others; glaciolacustrine diamicton according to this paper (see Thorson and others, 1981, p. 409).
* 12.5	-	20.7 m	Sand, cross-bedded, some peat at 16 m.
* 20.7	-	26.8 m	Sandy gravel; at 22 m leg bone of Mammuthus, dated collagen.
26.8	-	28.5 m	Fine silt, sand.
* 28.5	-	30 m	Sand, cross-bedded with peaty beds and lenses. At 29 m sample of peat.
30	-	50 m	Peaty sand.
50	-	55 m	Bedded silt and clay.

Collector, date: R.M. Thorson and others, 1980
Reference: Dates listed and discussed in Thorson and others, 1981.

Map Location: Q

Susitna River Bluff west of mouth of Oshetna River. The section was largely covered when visited by D.R. Nichols in 1984, but apparently organic material was collected by Thorson in 1980 (Thorson and others, 1981, p. 409) who found a reworked wood fragment in ice-contact stratified drift; and a sample of wood from the highly deformed lacustrine sediments that interfinger with till was collected by Woodward and Clyde (1982).

Lab	Date	Significance of date
BETA-1822	24,900 ± 325	Reworked wood in ice-contact stratified drift.
GX-8058	>37,000	Contact between lacustrine fine sand and interfingered till.

Collector, date: R.M. Thorson and others, 1980
Reference: Thorson and others, 1981, p. 409.; Woodward & Clyde, Woodward Clyde Consultants, 1982, table 3-2.

Map Location: R

Lab	Date	Significance of date
W-1304	5,850 ± 320	Dates lower peat in horizontal sand that truncates gravel beds disturbed by growth of ice mass in permafrost (see W-717).
W-717	6,910 ± 250	Provides maximum age for deformation of enclosing unit during formation of underlying ice mass.

Stratigraphic section (* denotes sample horizon)

	0	- 0.60 m	Horizontally stratified sand and thin peat beds. Samples lowermost peat (W-1304).
*	0.60	- 1.2 m	Contorted gravel containing peat at about 1.2 m (W-717).
	1.2	- 2 m	Ice mass within pebbly clay lacustrine deposits.

Collector, date: D.R. Nichols, 1954
Reference: Written comm. Rubin and Alexander to D.R. Nichols, 1963; Nichols, 1965, p. 173, and fig. 1.

Map Location: S

Lab	Date	Significance of date
I-11,377	5,950 ± 105	Logs from basal deposits of 8.3 m-terrace, Tolsona Creek.

Stratigraphic section (* denotes sample horizon)

	0 -	1.53 m	Stratified pebble, small-cobble gravel.
	1.53 -	2.14 m	Coarse cobble gravel containing sticks and logs at base and in underlying sand.
*	2.14 -	2.60 m	Stratified sand containing logs and sticks.
	2.60 -	5.04 m	Alternating medium and fine, silty blue gray sand; laminated.
	5.04 -	5.95 m	Blue gray clay, varved (?).
	5.95 m		River level; cover and slump.

Collector, date: J.R. Williams, 1957
Reference: Teledyne Isotopes Inc., Westwood NJ., written commun., 9, June 1980.

Map Location: T

Lab	Date	Significance of date
W-583	13,280 ± 400	Minimum age of outwash gravel leading from moraine 1.3 km south to a broad fan or delta in lake to northeast; lake is part of regional lake at 760 m.

Stratigraphic section (* denotes sample horizon)

	0 -	0.53 m	Humus and peat.
*	0.53 -	0.95 m	Silt or clay with peat beds (sampled basal peat).
	0.95 -	1.08 m	Light gray silt with admixed pebbles and thin ashy zones.
	1.08 -	1.23 m	Leached sandy gravel (outwash).
	1.23 -	1.61 m	Oxidized sandy gravel (outwash).
	1.61 m		Cover and slump to pond level.

Collector, date: J.R. Williams, 1954
Reference: Rubin and Alexander, 1960, p. 168; Ferrians and Nichols, 1965, p. 111.

Map Location: U

Lab	Date	Significance of date
I-11,497	3,980 ± 105	Log from organic silt of filled beaver pond, upper Mendeltna Creek.

Stratigraphic section (* denotes sample horizon)

0	-	0.15 m	Surface peat and moss.
0.15	-	0.40 m	Frozen brown silt, scattered ice veins, little organic material.
0.40	-	0.42 m	Dark to black frozen peat and fetid organic silt.
* 0.42	-	1.7 m	Brown organic silt, frozen, ice veins and wedges as wide as 0.15 m. Beaver-chewed sticks; sampled log at depth of 0.68 m below to of exposure.

Collector, date: J.R. Williams, 1954
Reference: Teledyne Isotopes Inc., Westwood NJ., written commun., 26, Aug. 1980.

Map Location: V

Lab	Date	Significance of date
I-11,498	530 ± 75	Pond or alluvial-fan silt and peat deposits forming top of terrace about 30 m above Tazlina River.

Stratigraphic section (* denotes sample horizon)

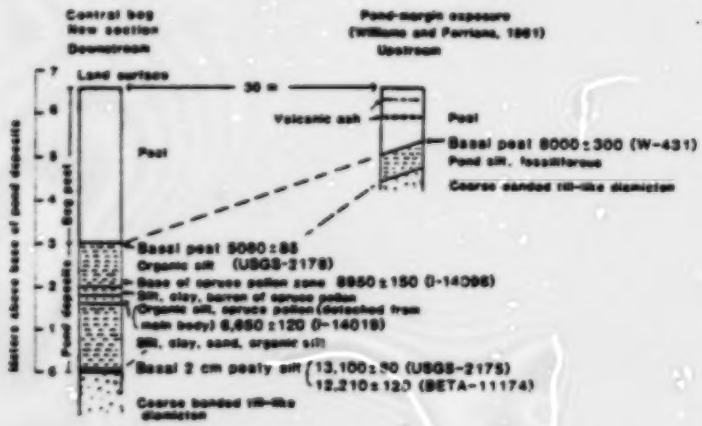
Sample collected 0.91 m below land surface in a secition of alternating contorted peat and silt beds.

Collector, date: J.R. Williams, 1954
Reference: Teledyne Isotopes Inc., Westwood NJ., written commun., 8, Sept. 1980.

Map Location: W

Lab	Date	Significance of date
USGS-2176 center of bog	5,060 ± 85	Basal peat date in bog post-dates last occupancy of sit by Matanuska Glacier, which now terminates less than 2,000 m upstream. Dates from upper units provides history of bog and advent of spruce during its migration in postglacial time.
W-431 approx 30 m east of section measured.	8,000 ± 300	
I-14,096	8,950 ± 150	Sample of basal 2 cm contains spruce pollen which is not in overlying materials; this and anomalously young date suggests slumping or slippage of sample horizon.
I-14,019	6,650 ± 120	
BETA-11174	12,210 ± 120	
USGS-2175	13,100 ± 60	

Stratigraphic section



Cross-section of part of Matanuska Glacier bog exposed at top of river bluffs 1.83 km west of glacier terminus and stratigraphic location of radiocarbon-dated samples (Williams, 1986).

Collector, date: O.J. Ferrians, Jr., and J.R. Williams, 1954
Reference: Williams and Ferrians, 1961; Rubin and Alexander, 1958, p. 1481.
Collector, date: O.J. Ferrians, Jr., H.R. Schmoll, J.R. Williams, L.A. Yehle, and D.R. Nichols, 1984.
Reference: Williams 1986; Teledyne Isotopes Inc., Westwood NJ., written commun., 22, May. 1985; Teledyne Isotopes Inc., Westwood NJ., written commun., 22, May. 1985; BETA Analytic Inc., written commun., 12, Dec. 1984.

Map Location: X

Lab	Date	Significance of date
W-573	3,620 ± 250	Dated soil profile on outwash gravel overlain by talus provides minimum age for outwash and maximum age for talus at thsi locality.

Stratigraphic section (* denotes sample horizon)

	0	- 0.15 m	Most and modern soil.
	0.15	- 1.41 m	Angular silty cobble-boulder gravel, talus.
	1.41	- 1.45 m	Persistent soil horizon of organic rich silt.
	1.45	- 1.46 m	White ash.
*	1.46	- 1.51 m	Oxidized silt, with organaic pods and charcoal, part of old soil horizon.
	1.51	- 1.89 m	Oxidized pebbly to cobbly silt with local pods and bands of organic silt and ashy silt.
	1.89 m		To base gray brown well rounded cobble boulder gravel, outwash.

Collector, date: J.R. Williams, 1954
Reference: Rubin and Alexander, 1960, p. 168; Williams and Ferrians, 1961, p. 87.

Map Location: Y

Lab	Date	Significance of date
I-13,046	1,300 ± 80	Apparently reltated to landsliding or fan formation after cutting of modern canyon of the Matanuska River.

Stratigraphic section (* denotes sample horizon)

Surficial fluvial gravel.
Upper peat, former soil.
Sand or silty sand.
Lower peat, upper part is sedge sod; lower part (samples) is woody and includes spruce roots, *in situ* (?).

Collector, date: J.R. Williams, 1957
Reference: Teledyne Isotopes, Inc., Westwood, N.J., written commun., 24, June, 1983.

Map Location: Z

Lab	Date	Significance of date
I-11,397	8,480 ± 135	Provides minimum age for retreat of glacier and for end of deposition in subsequent glacial lake before fan deposits covered the site.

Stratigraphic section (* denotes sample horizon)

0	-	2.4 m	Alluvial fan mantle of peat and organic silt. at 2.4 m, gravel of fan.

Collector, date: J.R. Williams, 1978
Reference: Teledyne Isotopes, Inc., Westwood, N.J., written commun., 30, June 1980.

Map Location: AA

Lab	Date	Significance of date
I-11,126	2,170 ± 80	Intended to provide a minimum date for glacier retreat.

Stratigraphic section (* denotes sample horizon)

* 0 1.5 m	-	1.5 m	Surficial turf and peat (sampled base). Blue-gray silty sand.

Collector, date: J.R. Williams, 1978
Reference: Teledyne Isotopes Inc., Westwood NJ., written commun., 1, Feb. 1980.

Map Location: BB

Gakona Section, in two parts, (1) upper eolian deposits 0.5 km west of mouth of Gakona River, (2) lower glaciolacustrine section measured 1.2 km west of mouth of Gakona River in bluffs bordering Copper River.

Eolian deposits (1)

Lab	Date	Significance of date
W-1165	1,630 ± 350	Begining of accelerated eolian activity. Minimum age for arrival of
W-714	9,400 ± 300	spruce and for eoliana cliffhead dunes.

Stratigraphic section (* denotes sample horizon)

	0	- 0.9 m	Eolian sand, wood fragments and peat beds.
	0.9	- 2.1m	Eolian sand, scattered organic pieces.
	2.1	- 2.5 m	Interbedded peat, sand wood fragments.
*	2.5	- 4.3 m	Eolian sand, organic material lacking.
*	4.3	- 8.9 m	Interbedded peat and eolian sand, sampled lowest peat bed (W-714) and 2.5 m (W-1165).

Glaciolacustrine deposits (2)

Lab	Date	Significance of date
W-531	> 38,000	Dates initiation of last major glaciation.
GrN-4798	58,600 ± 1,100	

Stratigraphic section (* denotes sample horizon)

	0	- 3 m	Fine silty sand, interbedded organic material like eolian deposits (1) above.
	4.6	- 6.1 m	Coarse terrace gravel, sandy
	6.1	- 10.7 m	Gravelly silt (till like), a glaciolacustrine diamicton of last major glaciation.
	10.7	- 13.7 m	Poorly laminated silt with interspersed pebbles and cobbles, lacustrine of last major glaciation.
*	13.7	- 22.9 m	Coarse gravel grading upward into fine sand with included wood fragments that were submitted for analysis (W-531, and to Groningen laboratory). Base of deposits of last major glaciation, near sampled horizon. Unit at lower levels contains within it lacustrine deposits of an intermediate major glaciation (Ferrians, Nichols and Williams, 1983, p. 151).
	22.9	- 27.4 m	Till and lacustrine deposits and of an early major glaciation.

Map Location: BB (cont.)

Collector, date: O.J. Ferrians, Jr., and H.R. Schmoll, 1957/1958
Reference: Ferrians, 1963; Ferrians, Nichols and Williams, 1983; Rubin and Alexander 1960, p. 170-171.

Map Location: CC
Sanford River section, dating a withdrawal of lake below the 655 m level.

Lab	Date	Significance of date
W-1343 top of peat	28,300 ± 1,000	Dates a minimum age for last coverage of this area by glaciers.
W-843 basal peat	31,300 ± 1,000	Dates a time when regional lake level was rising from 645 m level to above that level.

Stratigraphic section (* denotes sample horizon)

0 to 3 m or 0 to 9 m eolian sand.
3 - 7.5 (or 13.5) m fine silty sand with stones and interbedded gravel.
7.5 -34.5 (13.5 - 40.5) m interbedded fine to medium grained sand and silt with some gravel horizons.
*Some peat beds near base.

Collector, date: O.J. Ferrians, Jr., and H.R. Schmoll, 1957
Reference: Rubin and Alexander, 1960, p. 171-172; Levin and others, 1965, p. 391; Karlstrom and others, 1964.

Map Location: DD

Lab	Date	Significance of date
W-377	>35,000	Major interglacial forest beds overlain by outwash and diamicton of last major glaciation.

Stratigraphic section (* denotes sample horizon)

0	-	3 m	Unoxidized stony silt mantled with surface vegetation.
3	-	7.6 m	Unoxidized outwash gravel.
* 7.6			Forest horizon
7.6	-	9.1 m	Slightly oxidized fine silty sand with organic material disseminated throughout.
9.1	-	10.7 m	Oxidized fine gravel and sand.
10.7	-	21.3 m	Cover to river level.

Collector, date: O.J. Ferrians, Jr., and H.R. Schmoll
Reference: Rubin and Alexander, 1958, p. 1482.

Map Location: EE

Lab	Date	Significance of date
I-276	>37,000	Dates time of transition from a fluvial to a lacustrine environment of deposition during the initial phase of last major glaciation.

Stratigraphic section (* denotes sample horizon)

	0	- 1 m	Eolian silt and fine sand.
	1	- 4.6 m	Poorly stratified silt with numerous pebble-sized phenoclasts.
	4.6	- 7.6 m	Lacustrine diamicton.
*	7.6		Laminated sand and silt containing wood.
	7.6 m		To river, sand and gravel and cover.

Collector, date: O.J. Ferrians, Jr., and H.R. Schmoll, 1958
Reference: Trautman, 1963, p. 62.

Map Location: FF

Lab	Date	Significance of date
I-271	> 29,000	Minimum age for till.

Stratigraphic section (* denotes sample horizon)

	0	- 4.6 m	Terrace gravel.
*	4.6	- 15.2 m	Till in middle of which tree limb was exposed for collection, underlain by fluvial sand and gravel, lacustrine silt, and till.

Collector, date: D.R. Nichols, 1955
Reference: Trautman, 1963, p. 63.

Map Location: GG

Lab	Date	Significance of date
W-806 base	8,720 ± 300	Date begining and end of a period of
W-809 top	8,000 ± 300	peat deposition preceded and followed by alluviation.

Stratigraphic section (* denotes sample horizon)

	0 - 0.3 m		Vegetation mat, largely peat.
	0.3 - 1.0 m		Fine sand and silt, floodplain deposits.
	1.0 - 3.4 m		coarse alluvial sand.
*	3.4 - 4.0 m		Peat, including twigs especially in upper part (W-806 lowest .05 m; W-809 highest .05 m).
	4.0 - 7.0 m		Bedded silt, alluvial

Collector, date: O.J. Ferrians, Jr., and H.R. Schmoll
Reference: Rubin and Alexander, 1960, p. 172-173.

Map Location: HH

Lab	Date	Significance of date
W-848	11,390 ± 300	Dates return of lake level to altitude above peat bed and provides minimum date for retreat of glacier from site.

Stratigraphic section (* denotes sample horizon)

	0 - 0.9 m		Peat, including modern vegetation.
	0.9 - 1.8 m		Bedded silt and clay.
*	1.8 - 1.9 m		Peat, twigs sampled from upper 0.06 m.
	1.9 - 6.5 m		Laminated silt and clay.
	6.5 - 9.6 m		Well bedded medium sand
	9.6 - 11.1 m		Cover to river level.

Collector, date: O.J. Ferrians, Jr., and H.R. Schmoll, 1972
Reference: Rubin and Alexander, 1960, p. 172.

Map Location: II

Lab	Date	Significance of date
W-985	6,960 ± 290	Upper and lower peat samples within an alluvial sequence.
W-1164	7,880 ± 400	

Stratigraphic section (* denotes sample horizon)

Gravel and sand.
*Peat with interbedded silt and sand; W-1164 is lowermost 0.05 m of peat; W-985 is uppermost 0.05 m.

Collector, date: O.J. Ferrians, Jr., and H.R.Schmoll, 1958
Reference: Ives and others, 1964, p. 65.

Map Location: JJ

Lab	Date	Significance of date
W-1163	7,450 ± 400	Minimum age for regression of lake that covered sit during last major glaciation.

Stratigraphic section (* denotes sample horizon)

* 0	-	0.9 m	Surface peat unit. Sampled base.
	on		Unsorted sandy silt with numerous scattered Pebbles, cobbles and boulders (lacustrine diamicton).

Collector, date: O.J. Ferrians, Jr., and H.R. Schmoll, 1955
Reference: Ives and others, 1964, p. 61.

Map Location: KK

Lab	Date	Significance of date
W-1337	> 38,000	Dates period during last major glaciation when extensive proglacial lake in Copper River Basin was higher than 610 m above sea level (2,000 ft).

Stratigraphic section (* denotes sample horizon)

Diamicton.
Sand.
Fine gravel.
*Sand, middle of 0.6 m thick unit contains wood fragments.

Collector, date: O.J. Ferrians, Jr., and H.R. Schmoll, 1957
Reference: Levin and others, 1965, p. 391.

Map Location: LL

Keg Creek Section.

Lab	Date	Significance of date
W-5656	9,950	Taken from 18-23-m high west bank of Keg Creek from lacustrine sand, silt, and clay tilted 15° to 40° to north on vertical sand and gravel and sand on till. Provides minimum dates for glacial retreat; collapse of lake sediments perhaps in post-glacial warming of ice in permafrost.
W-5657	10,260	

Stratigraphic section (* denotes sample horizon)

	Top of bank.
3.6 m	Sand, silt, clay.
*	Thin zone of twigs (W-5656).
9 m	Sand, silt, clay.
5 cm	Organic zone.
	Sand silt, clay
* 2.57 cm	Peat (W-5657).
1.5 m	Sand, silt clay.
3.5 m	Gravel, and vertical sand.
	Till.

Collector, date: D.R. Nichols
Reference: D.R. Nichols;, oral commun., 1985; written commun.1984; D.R. Nichols to Meyer Rubin, 30, Sept. 1985.

Map Location: MM

Copper center alluvium.

Lab	Date	Significance of date
W-1089	4,170 ± 250	Two decomposed iron stained logs, the younger (W-1089) from 1.07 m below surface, the other from below 1.5 m.
W-969	>38,000	

Stratigraphic section (* denotes sample horizon)

* 0	-	1.5 m	Terrace sand and gravel, sample at 1.07 m.
* 1.5 m			and below, sample W-969.

Collector, date: D.R. Nichols, 1958
Reference: Ives and others, 1964, p. 61, 67.

Map Location: NN

Lab	Date	Significance of date
W-568	9,000 ± 400	Basal organic material of pond deposits on north bank Nadina River. Provides minimum age for withdrawal of the glacier and of the glacial lake that followed.

Stratigraphic section (* denotes sample horizon)

Basal peat and twigs from section exposing fluvial and eolian deposits above the silty and sandy lacustrine (local pond) that overlie outwash and till of last major glaciation.

Collector, date: D.R. Nichols, 1956
Reference: Rubin and Alexander, 1960,

Map Location: OO

Lab	Date	Significance of date
W-307	>37,000	Partially lignitized peat and wood in soil horizon overlying greenish-gray till and underlying nearly 30 m of outwash and terrace gravel; interglacial soil is elsewhere overlain by two younger till units.

Stratigraphic section (* denotes sample horizon)

0	-	3.2 m	Bedded eolian (?) sand and silt.
3.2	-	21.4 m	Outwash gravel with boulder beds and sand lenses near top.
21.4	-	22.9 m	Medium-fine sand, woody zones.
22.9	-	26.1 m	Pebble and cobble gravel.
26.1	-	30.7 m	Sand and pink fine sand, some wood.
* 30.7	-	31.7 m	Buried soil.
31.7	-	37.8 m	Greenish-gray till (or diamicton), rudely stratified in lower part.
37.8	-	42.4 m	Slump to river.

Collector, date: D.R. Nichols, 1954
Reference: Rubin and Alexander, 1958,

DEPARTMENT OF THE INTERIOR
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EXPLANATION

Bottom deposits of 914 - 975 m lake

Overprint denoting glacial drift that is mantled by bottom sediments of glacial lake that extended to 914 - 975 m above modern sea level, largely confined to middle Susitna valley, above ice dam below Fog Lake (off map) and apparently bounded on east and south side by glacier ice. Does not cover late(st) Wisconsin (last major) morainal systems. No shoreline features are mapped.

Bottom deposits intermediate (777 - 747) lake

Overprint denoting bottom deposits of a local lake that covered melting glacier ice between Tyone Lake and Lake Louise, apparently behind Tyone Spillway, and drained as the elevation of the spillway was cut down from 777 m to 747 m above sea level while stagnant ice was still in valley bottom.

Bottom deposits of last regional lake

Overprint denoting drape of bottom deposits over drift and thick lake sediments that persisted in Copper River drainage basin from just before deposition of Old Man moraines to a time when glaciers had retreated to within 16 to 24 km of present glaciers: older than 13,000 years.

SYMBOLS

△ AA — Location and letter designation of radiocarbon-dated stratigraphic section in accompanying text.

Ice boundary, morainal ridge, kame terrace, delta, or other ice contact feature marking edge of glacier: hachures toward glacier.

Shoreline of regional lake: mapped for the lake in Copper River basin where at 747 m (maximum elevation); the elevation to which Tyone Spillway was eroded, and successively lower levels in the northern part of area between 747 m and 701 m above sea level. Lesser recessional shorelines mapped by Nichols and Yehle (1969) not shown.

Upper limit of post-glacial (Holocene, in part) shoreline of Tazlina Lake from elevation 564 m down to present lake level 544 m caused by lowering of lake as Tazlina River has deepened its canyon.

Delta of glacial lake, including those of modern glacial lakes such as Tazlina Lake.

Linear or drumlinoid feature, due to ice scour, direction of ice movement indicated by arrow.

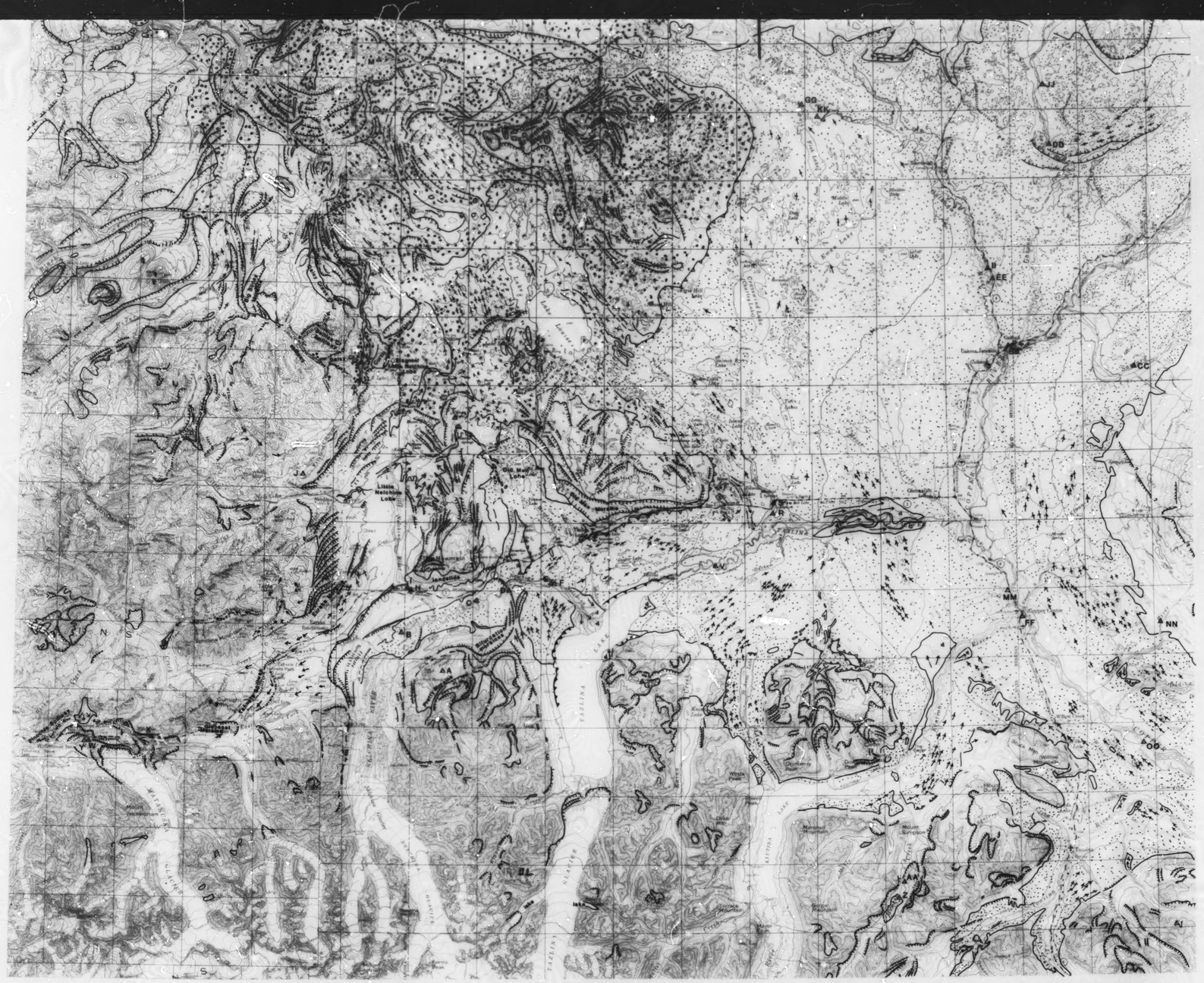
Spillway for glacial meltwater, including that stored in large glacial lakes.

Contact between map units where not glacial boundary, most commonly between different levels of lake deposits.

D / U — Active (?) fault, lower Sonona Creek, offsetting unconsolidated deposits.

Location of selected erratic boulders, mountain top erratic stones transported by glaciers, e.g. Sheep Mountain; many occurrences on mountains lower than 1829 m not shown.

F1



Base: U.S. Geological Survey, compiled from the following 1:250,000 quadrangle: Anchorage, Gulkana, Talkeetna Mts, and Valdez.

scale 1:250,000

0 5 10 15 20 MILES

0 5 10 15 20 25 KILOMETERS

contour interval 200 feet

Geologic mapping by J.R. Williams, assisted by Meyer Rubin and D.U. Wise, 1952, O.J. Ferrians, Jr., 1953-1954, Livingston, Chase, 1957, and C.L. Connor, 1980; by O.J. Ferrians, Jr., northeastern part 1955-60, assisted by H.R. Schmoll; by D.R. Nichols, Gulkana Hills, 1959; and from published reports by Nichols and Yehle, 1961, 1969, Williams and Johnson, 1980, Williams and Ferrians, 1961, and reports listed in references.

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Refer to text for description of stratigraphic sections and radiocarbon dates.

MAP OF WESTERN COPPER RIVER BASIN, ALASKA, SHOWING LAKE SEDIMENTS AND SHORELINES, GLACIAL MORAINES, AND LOCATION OF STRATIGRAPHIC SECTIONS AND RADIOCARBON-DATED SAMPLES

by

John R. Williams and John P. Galloway

1986

F2

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.